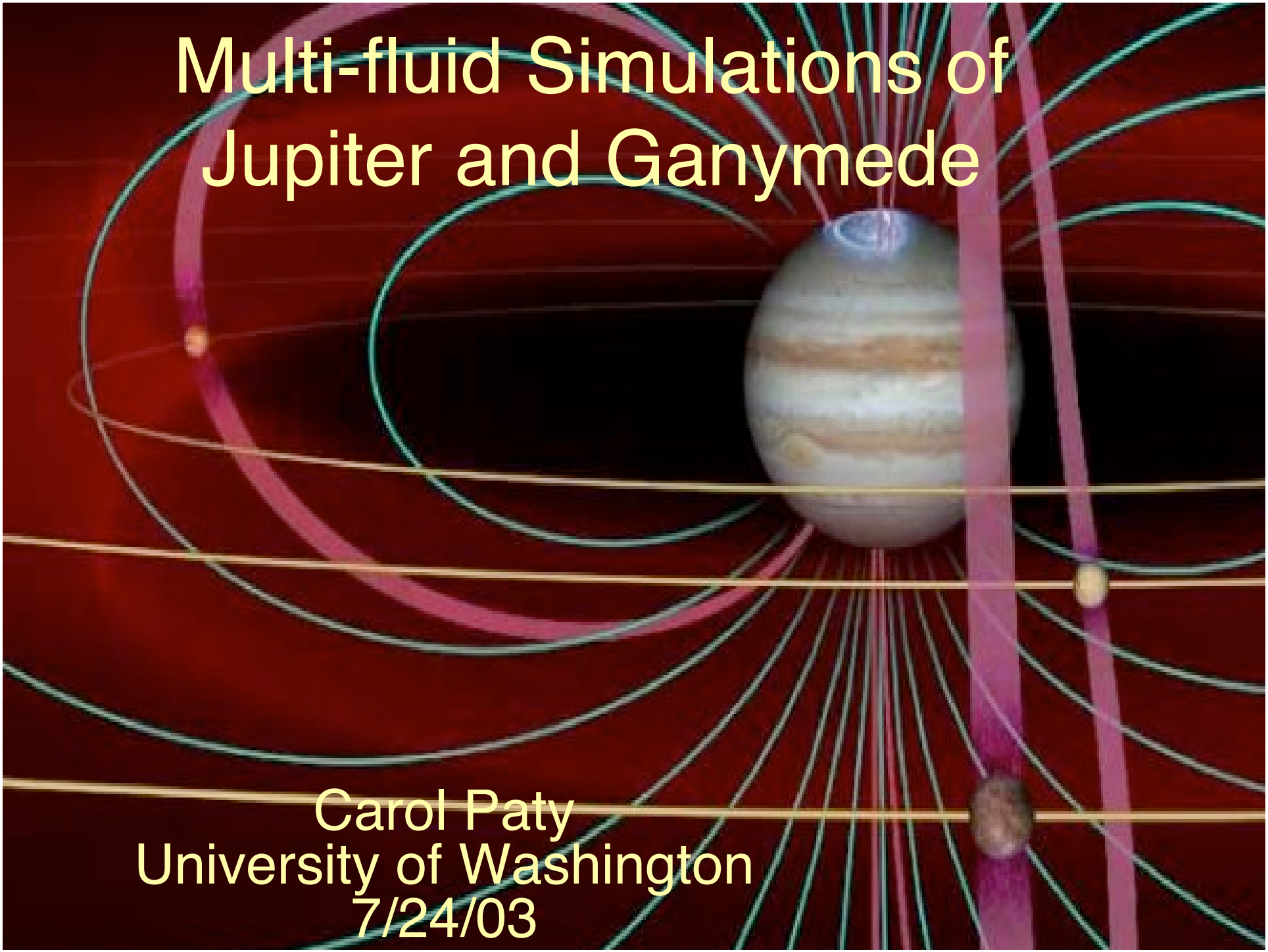
Multi-fluid Simulations of Jupiter and Ganymede



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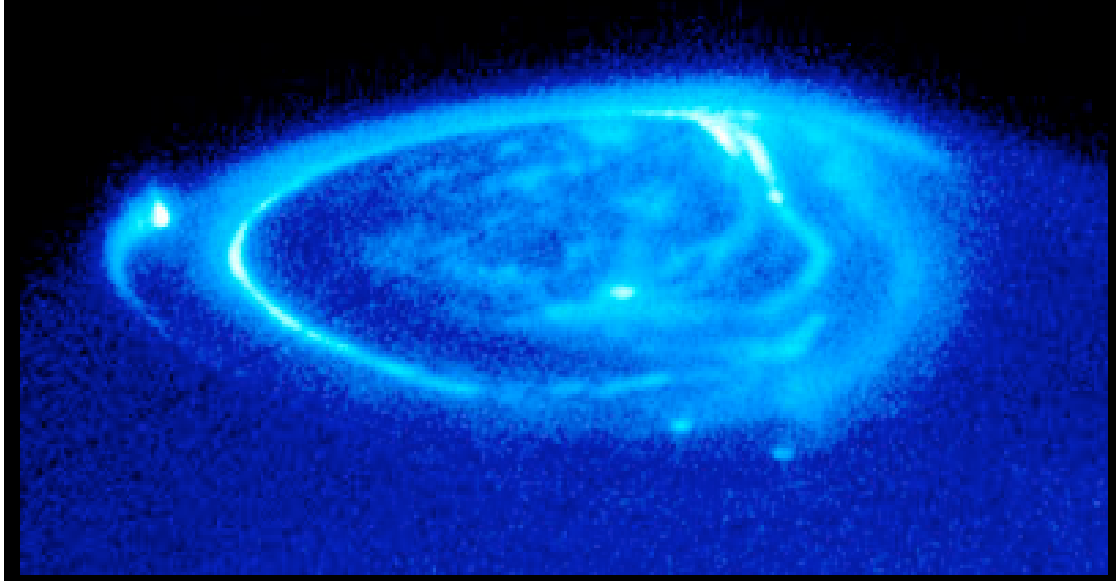
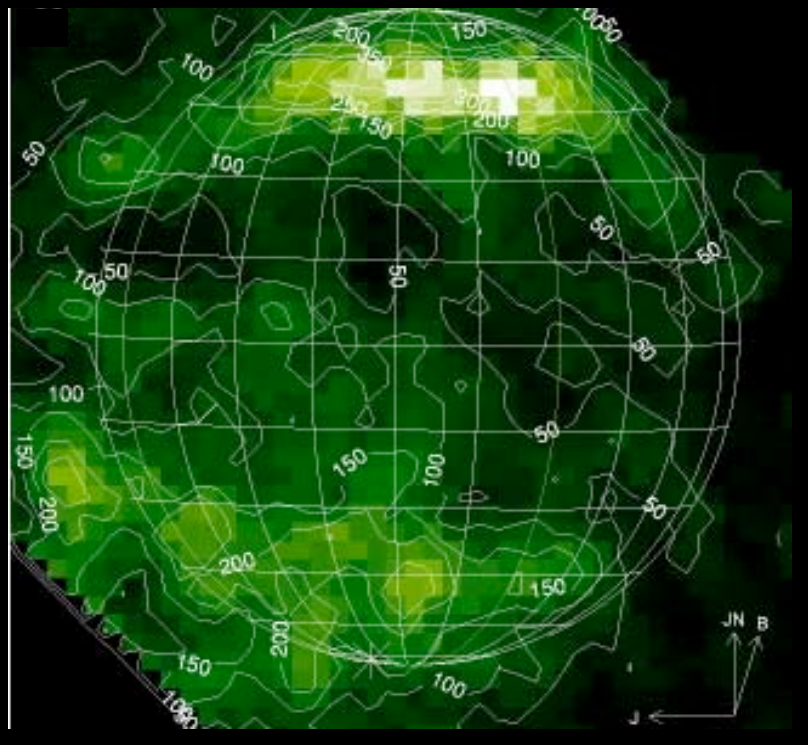
7/24/03

Auroral Observations



Clarke et al,1998



Feldman et al., 2000

Modeling: Multi-Fluid

$$\frac{\partial \rho_s}{\partial t} + \nabla \cdot \left(\rho_s \vec{\mathbf{v}}_s \right) = 0$$

$$\rho_s \frac{d\vec{\mathbf{v}}_s}{dt} = q_s n_s \left(\vec{E} + \vec{\mathbf{v}}_s \times \vec{B} \right) - \nabla p_s$$

$$\frac{\partial p_s}{\partial t} = -\gamma p_s \nabla \cdot \left(\rho_s \vec{\mathbf{v}}_s \right) + (\gamma - 1) \vec{\mathbf{v}}_s \cdot \nabla p_s$$

$$\vec{E} = -\vec{\mathbf{v}}_i \times \vec{B} + \frac{\vec{J} \times \vec{B}}{e n_e} + \frac{\nabla p_e}{e n_e} + \eta \vec{J}$$

- Differs from MHD in that….
  - Includes more particle physics terms
  - Can have many different fluids (s) communicating
  - Collisionless space plasma

Different Drift Speeds

Hall term

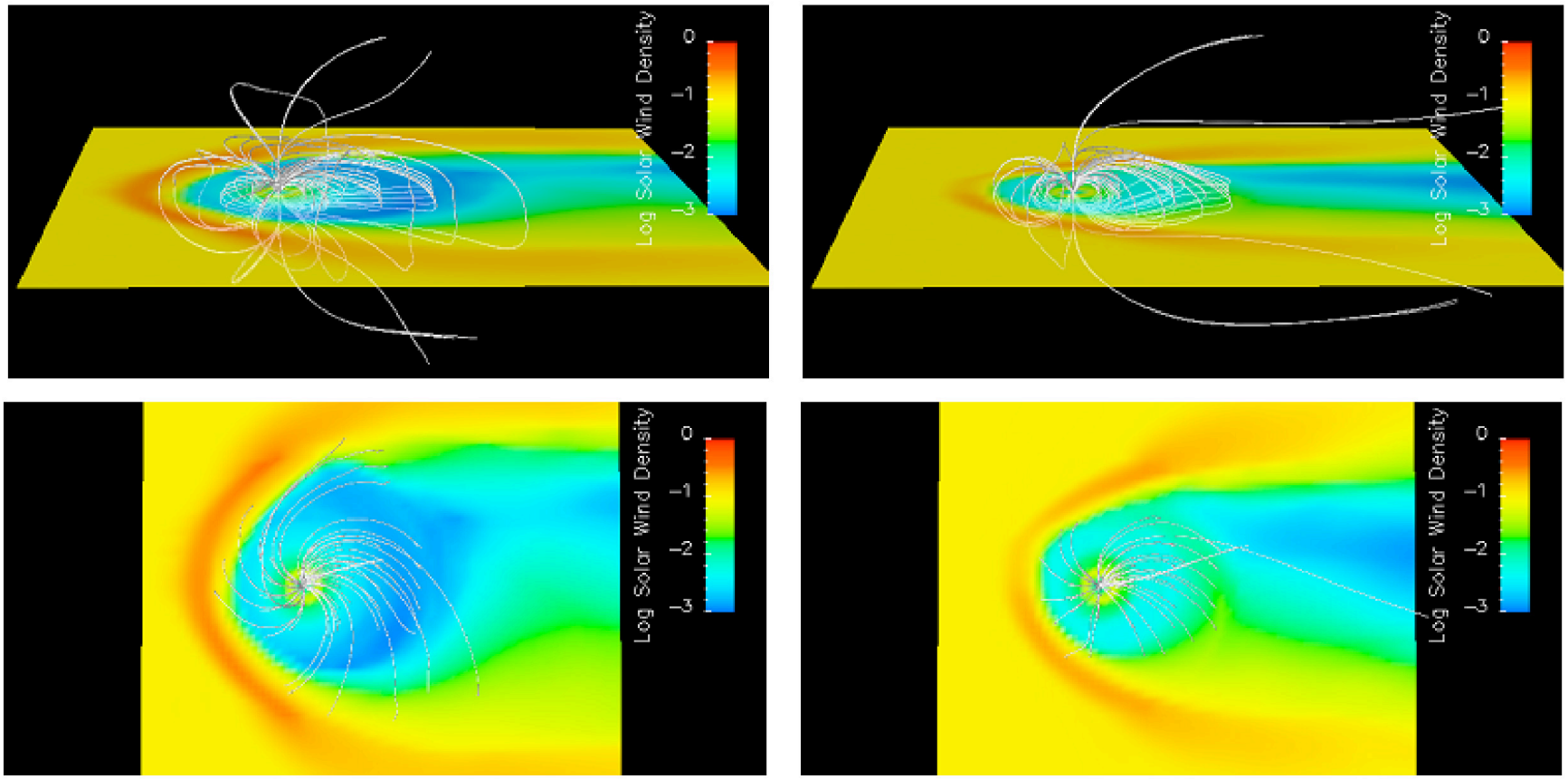
Electron Thermal Expansion

Collisional Ionospheric Resistivity

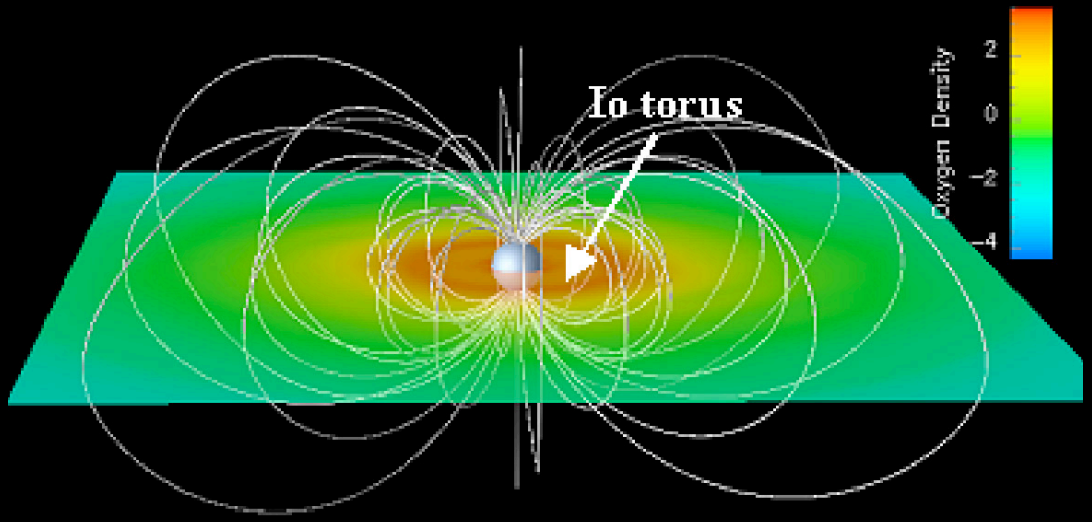
Ionospheric Outflow

(a) Outflow rate 4×10^{30} amu/s

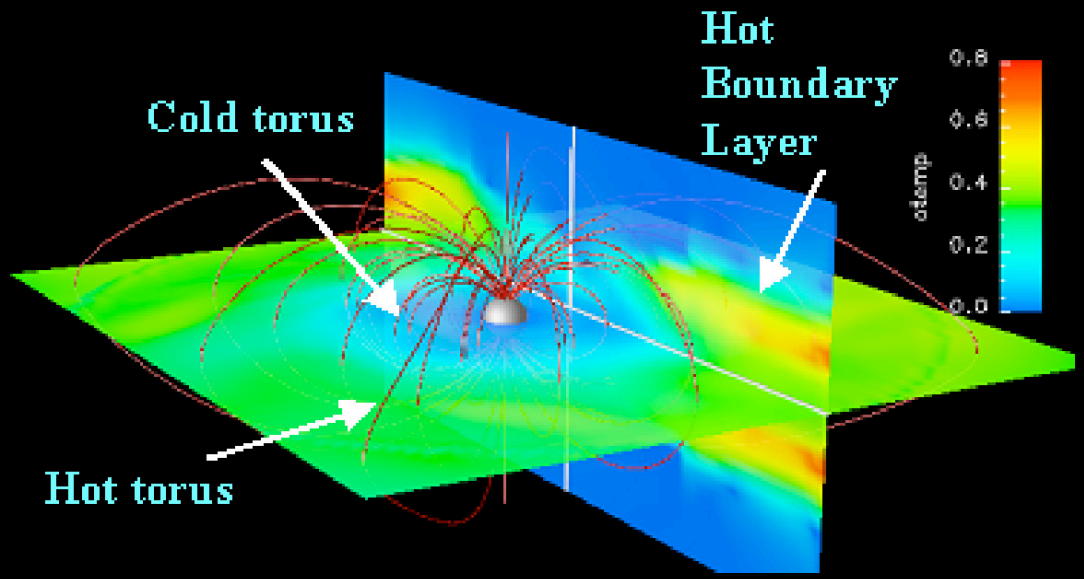
(b) Outflow rate 10^{30} amu/s



(a) Heavy Ions Density



(b) Heavy Ions Temperature



Model Capabilities:

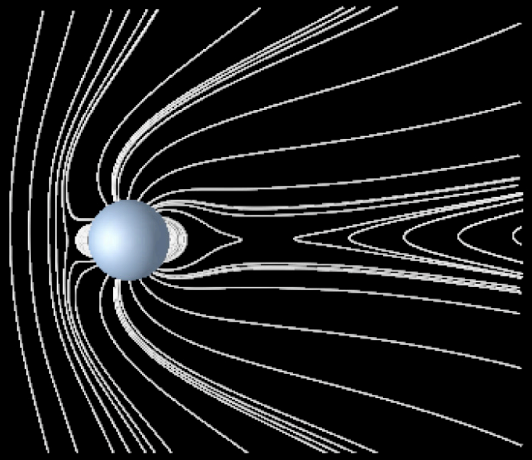
Model down to 2 Jupiter radii

Resolution of Inner Magnetospheric Features

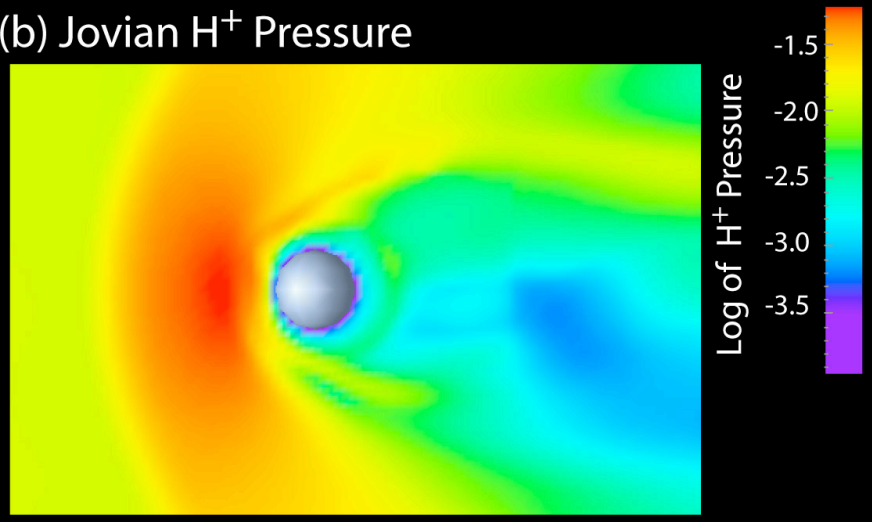
Differentiate between ion species

Ganymede

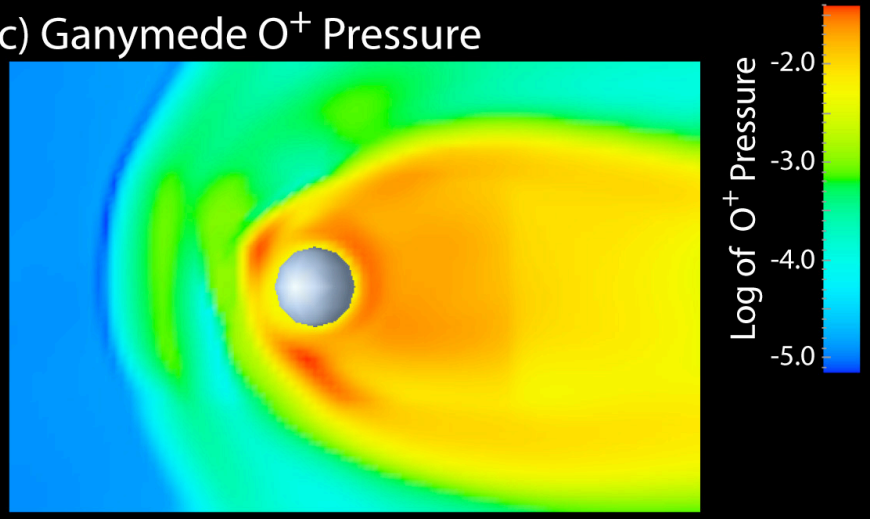
(d) Ganymede's field lines: side view



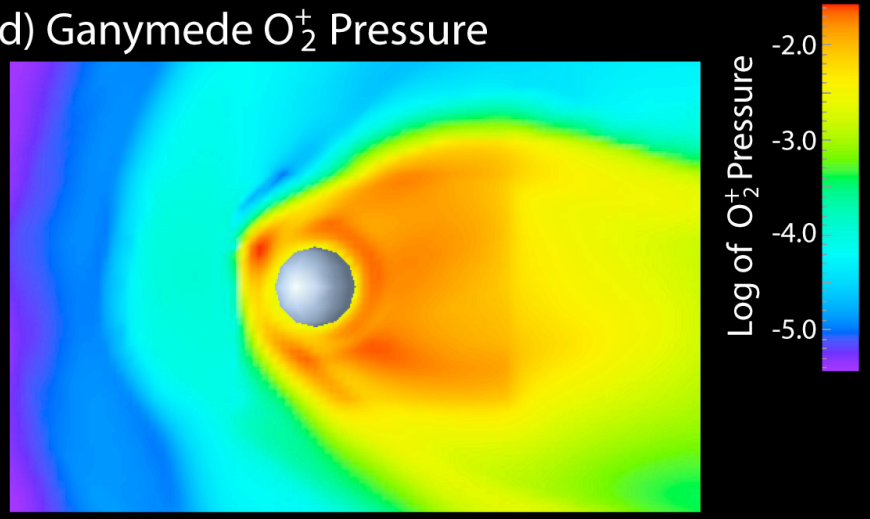
(b) Jovian H^+ Pressure



(c) Ganymede O^+ Pressure



(d) Ganymede O_2^+ Pressure



Future Grid Set-up